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BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte PETER A. BEEREL, KEITH M. CHUGG, GEORGIOS D.
DIMOU, and PHUNSAK THIENNVIBOON

Appeal 2008-002315
Application 09/848,778
Technology Center 2100

Decided: July 22, 2009¹

Before JEAN R. HOMERE, JOHN A. JEFFERY, and DEBRA K.
STEPHENS, *Administrative Patent Judges*.

STEPHENS, *Administrative Patent Judge*.

DECISION ON APPEAL

¹ The two-month time period for filing an appeal or commencing a civil action, as recited in 37 C.F.R. § 1.304, begins to run from the decided date shown on this page of the decision. The time period does not run from the Mail Date (paper delivery) or Notification Date (electronic delivery).

STATEMENT OF THE CASE

Appellants appeal under 35 U.S.C. § 134(a) from a final rejection of claims 1-19 and 36-102 under 35 U.S.C. §103(a). We have jurisdiction under 35 U.S.C. § 6(b).

We affirm.

Introduction

According to Appellants, the invention is a system and method relating to techniques for iterative detection or decoding of concatenated codes (Spec. 1, Field of the Invention).

Exemplary Claim

Claim 1 is an exemplary claim and is reproduced below:

1. A decoding method comprising:
receiving an encoded signal;
demodulating the received encoded signal to produce soft information; and
iteratively processing the soft information with one or more soft-in / soft-output (SISO) modules, at least one SISO module using a tree structure arranged to perform parallel prefix and suffix operations to compute forward and backward state metrics.

Prior Art

The prior art relied upon by the Examiner in rejecting the claims on appeal is:

Viterbi

US 5,933,462

Aug. 2, 1999

F. Thomson Leighton, *Introduction to Parallel Algorithms and Architectures: Arrays Trees-Hypercubes* 1-3, 36-45, 238, 239 (1992).

S. Benedetto et al., *Soft-Output Decoding Algorithms in Iterative Decoding of Turbo Codes*, TDA Progress Report 42-124, Feb. 15, 1996 at 63.

Rejections

The Examiner rejected claims 1, 2, 6-12, 15-17, 19, 36-38, 42-47, 50-52, 61-63, 67-71, 74-76, 85-90, 93, 94, 97, 98, 101 and 102 are rejected under 35 U.S.C. § 103(a) as being obvious over Viterbi and Thomson Leighton.

The Examiner rejected claims 3-5, 13, 14, 18, 39-41, 48, 49, 53-60, 64-66, 72, 73, 77-84, 91, 92, 95, 96, 99, and 100 are rejected under 35 U.S.C. § 103(a) as being obvious over Viterbi, Thomson Leighton, and Benedetto.

GROUPING OF CLAIMS

Appellants present essentially the same arguments for all claims on appeal regarding the alleged impropriety of the Examiner's combination of cited references as argued for claim 1 (App. Br. 7-20, ¶ (7)1. – (7)2.). We will, therefore, treat claims 2, 6-12, 15-17, 19, 36-38, 42-47, 50-52, 61-63, 67-71, 74-76, 85-90, 93, 94, 97, 98, 101 and 102 as standing or falling with claim 1. We also treat claims 3-5, 13, 14, 18, 39-41, 48, 49, 53-60, 64-66, 72, 73, 77-84, 91, 92, 95, 96, 99, and 100 separately.

We accept Appellants' grouping of the claims. *See* 37 C.F.R. § 41.37(c)(1)(vii) ("Notwithstanding any other provision of this paragraph, the failure of appellant to separately argue claims which appellant has grouped together shall constitute a waiver of any argument that the Board must consider the patentability of any grouped claim separately.").

Appellants' Contentions

With respect to all claims on appeal, Appellants argue the Examiner is using hindsight to find a person having ordinary skill in the art would have combined the system of Viterbi with the parallel processing of Thomson Leighton “to speed processing up” (App. Br. 8, l. 24 – App. Br. 9, l. 3). Appellants contend Viterbi uses serial processing to compute state metrics to reduce memory consumption and the amount of data to be stored (App. Br. 9, ll. 17-21). Thus, Appellants argue, if Viterbi were modified to use the parallel computation, the modified system and method would contradict Viterbi’s teaching of reducing memory which is an improper combination (App. Br. 10, l. 2 – App. Br. 11, l. 12).

Appellants then contend the Examiner does not provide a motivation to make the combination of Viterbi and Thomson Leighton, as Viterbi teaches a system performing serial operations to reduce memory consumption, while Thomson Leighton teaches arrays and trees (App. Br. 11, l. 12 – App. Br. 14). Appellants argue Thomson Leighton suggests use of the parallel prefix operation may not improve the number of steps of the algorithm (App. Br. 12, ll. 1-5). Moreover, Appellants argue Thomson Leighton does not teach or suggest its teachings could be used in soft input/output decoders, the parallel prefix operation could be used in such a decoder, or the parallel prefix operation would speed up the computation (App. Br. 12, ll. 13-17). Appellants further contend one of ordinary skill in the art would not have been motivated since parallel prefix computations were not taught to compute state metrics and Viterbi’s data dependency prevents parallelization (App. Br. 14, l. 10 – App. Br. 15, l. 14).

Examiner's Findings

The Examiner finds if the word “parallel” were removed from the limitation “prefix and suffix operations” in claim 1, then Viterbi would teach each and every element of claim 1 (Ans. 16, ll. 14-17). Further, the Examiner finds one of ordinary skill in the art at the time would have been highly motivated to combine Viterbi with Thomson Leighton “recognizing that the computations in Viterbi are computationally intensive and the parallel prefix and suffix computations in Thomson Leighton provide a parallel algorithm used for computationally intensive algorithms to speed processing up” (Ans. 5, ll. 17-22). The Examiner further finds the reasoning does not involve hindsight using knowledge gleaned from Appellants’ disclosure, but instead, takes into account only knowledge within the level of ordinary skill at the time the claimed invention was made (Ans. 17, ll. 8-14).

In response to Appellants’ argument that including parallel processing in Viterbi would no longer reduce the memory consumption in the way suggested by Viterbi, the Examiner finds Viterbi does not teach away from parallel processing, since Thomson Leighton teaches prefix and suffix operations apply for the SOVA decoder taught by Viterbi (Ans. 20, ll. 1-16). The Examiner further finds Viterbi does not teach any data dependencies associated with calculations of the prefix and suffix operations as Viterbi does not teach how to calculate the prefix and suffix operations (Ans. 24, ll. 6-15).

Issue

Have Appellants met the burden of showing the Examiner erred in concluding Appellants' invention, as claimed, was taught or suggested by the combination of the parallel processing of Thomson Leighton and the soft-in/soft-out module of Viterbi because:

- a) combining the parallel processing of Thomson Leighton into the soft-in/soft-out module of Viterbi uses hindsight;
- b) Viterbi teaches away from including parallel prefix and suffix operations to compute forward backward state metrics; and
- c) a person of ordinary skill in the art would not have been motivated to combine the parallel processing of Thomson Leighton into the system of Viterbi?

FINDINGS OF FACT (FF)

Appellants' Invention

(1) Appellants' system is directed to techniques for iterative detection or decoding of concatenated codes and more specifically, to computing the soft-inverse of a finite-state machine as used in turbo decoders (Spec. 1, Field of the Invention).

Viterbi's Invention

(2) Viterbi describes a soft decision output decoder and decoding method (Abstract). Viterbi claims this method offers significant

performance gains without being memory intensive (col. 3, l. 66 – col. 4, l. 6).

(3) In the implementation, memory reduction is acquired using a single backward iteration (col. 9, ll. 59-60).

Thomson Leighton's Invention

(4) Thomson Leighton teaches parallel algorithms and architectures including arrays and trees (Title).

(5) The parallel prefix algorithm and prefix and suffix computations are taught (p. 1, Chapter 1; p. 38, Fig. 1-21; p. 239, prob. 1.27).

(6) Parallel prefix computations arise in a wide variety of applications (p. 1, Chapter 1; p. 42, § 1.2). Additionally, parallel prefix computations are so common that algorithms for their computations are sometimes hardwired into parallel machines so they can be executed more rapidly as primitive operations (p. 42, § 1.2).

(7) The parallel prefix algorithm can be implemented with constant slowdown on any bounded-degree network in time proportional to the diameter of the network (*id.*).

PRINCIPLES OF LAW

Appellants have the burden on appeal to the Board to demonstrate error in the Examiner's position. *See In re Kahn*, 441 F.3d 977, 985-86 (Fed. Cir. 2006) ("On appeal to the Board, an applicant can overcome a rejection [under § 103] by showing insufficient evidence of *prima facie* obviousness or by rebutting the *prima facie* case with evidence of secondary

indicia of nonobviousness.”) (quoting *In re Rouffet*, 149 F.3d 1350, 1355 (Fed. Cir. 1998)).

Regarding the issue of hindsight when combining references to show obviousness, the U.S. Supreme Court in *KSR Int’l Co. v. Teleflex, Inc.*, 550 U.S. 398, 421 (2007), reaffirmed that “[a] factfinder should be aware, of course, of the distortion caused by hindsight bias and must be cautious of arguments reliant upon *ex post* reasoning.” (citation omitted). Nevertheless, in *KSR* the Supreme Court also qualified the issue of hindsight by stating that “[r]igid preventative rules that deny factfinders recourse to common sense, however, are neither necessary under our case law nor consistent with it.” *Id.*

Discussing the question of obviousness of claimed subject matter involving a combination of known elements, *KSR* explains:

When a work is available in one field of endeavor, design incentives and other market forces can prompt variations of it, either in the same field or a different one. If a person of ordinary skill can implement a predictable variation, § 103 likely bars its patentability. For the same reason, if a technique has been used to improve one device, and a person of ordinary skill in the art would recognize that it would improve similar devices in the same way, using the technique is obvious unless its actual application is beyond his or her skill. *Sakraida* [v. *AG Pro, Inc.*, 425 U.S. 273 (1976)] and *Anderson's-Black Rock*[, *Inc. v. Pavement Salvage Co.*, 396 U.S. 57 (1969)] are illustrative—a court must ask whether the improvement is more than the predictable use of prior art elements according to their established functions.

Id. at 417. If the claimed subject matter cannot be fairly characterized as involving the simple substitution of one known element for another or the mere application of a known technique to a piece of prior art ready for the

improvement, a holding of obviousness can be based on a showing that “there was an apparent reason to combine the known elements in the fashion claimed.” *Id.* at 418. Such a showing requires:

“some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness” [H]owever, the analysis need not seek out precise teachings directed to the specific subject matter of the challenged claim, for a court can take account of the inferences and creative steps that a person of ordinary skill in the art would employ.

Id. (quoting *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006)).

On the issue of whether a reference teaches away, the Court in *In re Gurley* 27 F.3d 551, 553 (Fed. Cir. 1994) stated:

A reference may be said to teach away when a person of ordinary skill, upon reading the reference, would be discouraged from following the path set out in the reference, or would be led in a direction divergent from the path that was taken by the applicant. The degree of teaching away will of course depend on the particular facts; in general, a reference will teach away if it suggests that the line of development flowing from the reference's disclosure is unlikely to be productive of the result sought by the applicant.

ANALYSIS

Appellants do not dispute and the facts support prefix and suffix computations, parallel prefix and suffix computations and parallel processing were known at the time of Appellants' invention (FF 4, FF 5, and FF 6). Both the technology taught in Viterbi and the techniques taught in Thomson Leighton are within the computer processing field and use the same techniques, such as tree structures and prefix computation (FF 3 and FF 4). Therefore, we find Appellants' argument that including parallel

prefix operations into the system of Viterbi uses hindsight to be unpersuasive.

Appellants additionally argue including parallel prefix and suffix operations in the system of Viterbi would conflict with the teachings of Viterbi due to data dependency issues that prevent parallelization and thus, would need to be resolved with undue experimentation (App. Br. 16, l. 6 – App. Br. 17, l. 1). However, Appellants provide no proof to overcome the Examiner’s finding. Instead, the arguments presented by Appellants (App. Br. 14, l. 4 – App. 17, l. 3), including data dependency issues, are not supported by teachings of Viterbi but instead are made by Appellants’ assumptions as to the basis of what Viterbi is teaching.

Additionally, we find Appellants have not presented evidence as to how the line of development flowing from the reference’s disclosure, introducing parallel prefix and suffix operations to Viterbi, would render Viterbi inoperable or is unlikely to be productive of the result Appellants’ have sought, performance benefits associated with a LOG-MAP decoder while avoiding the excessive memory requirements of the decoder (Viterbi, Abstract). Thus, Appellants have not met the burden of showing how Viterbi teaches away from use of a parallel prefix operation.

Appellants further argue an ordinary person skilled in the art would not have been motivated to combine the parallel prefix computation into the system of Viterbi to speed processing up as the Examiner finds, since Thomson Leighton discusses “how it may not improve the number of steps of the algorithm at all” (App. Br. 11, l. 16 – App. Br. 12, l. 4). We do not find any statement in Thomson Leighton that it will not speed the processing up. Instead, the teaching of Thomson Leighton indicates a parallel prefix

algorithm can be implemented with constant slowdown – teaching a tradeoff exists between time and diameter of the network (FF 7).

Additionally, Appellants argue Viterbi has data dependencies and therefore, cannot be parallelized and thus, one of ordinary skill in the art would not have been motivated to combine the references (App. Br. 14, l. 10 – App. Br. 15, l. 14); however, Appellants fail to indicate the specific teachings in Viterbi that support this data dependency or teach how prefix and suffix operations are calculated. We find the Examiner has articulated a reason with a rational underpinning and Appellants have not provided argument or evidence to overcome the Examiner’s prima facie case that a motivation existed to combine two well-known prior art elements.

Accordingly, we find incorporating the parallel prefix computation technique of Thomson Leighton into the system of Viterbi would have been a predictable use of prior art elements according to their established functions.

CONCLUSION

Based on the findings of facts and analysis above, we find Appellants have not met the burden of showing the Examiner erred in finding the invention as recited was taught or suggested by the combination of the parallel processing of Thomson Leighton and the soft-in/soft-out module of Viterbi because:

- d) combining the parallel processing of Thomson Leighton into the soft-in/soft-out module of Viterbi uses hindsight;

- e) Viterbi teaches away from including parallel prefix and suffix operations to compute forward backward state metrics; and
- f) a person of ordinary skill in the art would not have been motivated to combine the parallel processing of Thomson Leighton into the system of Viterbi.

Therefore, we conclude Appellants have not met the burden of showing the Examiner erred in concluding Appellants' invention, as recited, was taught and suggested by the combination of the parallel prefix computation of Thomson Leighton and the system of Viterbi. Thus, we find Appellants have not met the burden of showing the Examiner erred in rejecting claim 1 under 35 U.S.C. § 103(a) for obviousness over Viterbi and Thomson Leighton. Accordingly, Appellants have not met the burden of showing the Examiner erred in rejecting claims 2, 6-12, 15-17, 19, 36-38, 42-47, 50-52, 61-63, 67-71, 74-76, 85-90, 93, 94, 97, 98, 101 and 102 under 35 U.S.C. § 103(a) for obviousness over Viterbi and Thomson Leighton.

Obviousness Rejection Over Viterbi, Thomson Leighton, and Benedetto.

Regarding the obviousness rejections of claims 3-5, 13, 14, 18, 39-41, 48, 49, 53-60, 64-66, 72, 73, 77-84, 91, 92, 95, 96, 99, and 100 over Viterbi, Thomson Leighton, and Benedetto, we find that Appellants have not persuasively rebutted the Examiner's prima facie case of obviousness for these claims, but merely refer to the previous arguments made in connection with claim 1 (App. Br. 20).

Once the Examiner has satisfied the burden of presenting a prima facie case of obviousness, the burden then shifts to Appellants to present

evidence and/or arguments that persuasively rebut the Examiner's prima facie case. See *In re Oetiker*, 977 F.2d 1443, 1445 (Fed. Cir. 1992). Since Appellants did not particularly point out errors in the Examiner's reasoning to persuasively rebut the Examiner's prima facie case of obviousness, we will sustain the rejection for the same reasons indicated previously.

DECISION

The Examiner's rejection of claims 1, 2, 6-1, 15-17, 19, 36-38, 42-47, 50-52, 61-63, 67-71, 74-76, 85-90, 93, 94, 97, 98, 101 and 102 under 35 U.S.C. § 103(a) as being obvious over Viterbi and Thomson Leighton is affirmed.

The Examiner's rejection of claims 3-5, 13, 14, 18, 39-41, 48, 49, 53-60, 64-66, 72, 73, 77-84, 91, 92, 95, 96, 99, and 100 under 35 U.S.C. § 103(a) as being obvious over Viterbi, Thomson Leighton, and Benedetto is affirmed.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a)(1)(iv).

AFFIRMED

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